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Fleet Readiness Center East repairs Harrier using 3-D printing



Patternmaker Caleb Guelich, left, and engineer Justin Reynolds, both of Fleet Readiness Center East, inspect polymer form blocks made through fused deposition modeling, a type of additive manufacturing, also commonly referred to as 3-D printing. The form blocks, made in a matter of hours overnight on June 26 through mid-day June 27, were used to create repair parts for an AV-8B Harrier damaged during a hard landing on the USS Bataan (LHD 5) May 28. Using conventional methods, creating these tools could have taken two to three weeks. (U.S. Navy photo)

NAVAL AIR SYSTEMS COMMAND, PATUXENT RIVER, Md. — Marine Capt. William Mahoney had no idea that his [successful hard landing of an AV-8B Harrier](#), whose nose gear failed to deploy, on the deck of the USS Bataan (LHD 5) on May 28 would go viral, making him and the event a social media sensation.

While what happened to the aircraft next may not reach the same level of social media success as the video of the pilot from Marine Medium Tiltrotor Squadron (VMM) 263 (Reinforced), 22nd Marine Expeditionary Unit (MEU), it has shined a spotlight on how technicians aboard the Bataan and artisans at Fleet Readiness Center East (FRCE) located at Marine Corps Air Station Cherry Point, North Carolina, are using high-tech resources like 3-D printing to repair aircraft and quickly return them to the fleet.

Developed in the 1980s, NAVAIR has used Additive Manufacturing (AM) technology – also known as 3-D printing – to create tools and other products at FRCs for the past several



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years. AM is a process that creates three-dimensional objects of almost any shape using computer technology to sequentially deposit thin layers of liquid or powdered metals, polymers or other materials on a substrate.

"AM is a revolutionary technology," said Liz McMichael, NAVAIR's additive manufacturing integrated product team lead. "It has the potential to radically change how the Department of Defense, Department of the Navy, our partners and allies develop, produce and support their platforms and systems."

Doug Greenwood, a FRCE aerospace engineer who, along with maintainers onboard the Bataan, dismantled the nose cone of the Harrier to determine the extent of damage.

"The hard landing damaged a portion of one of the structural frames in the nose cone," Greenwood said. After assessing the damage and working with the on-board fleet support team, technicians came up with a strategy to repair the aircraft.

Because only one portion of the aircraft's frame was damaged, the team decided to cut out the damaged section and replace it with a matching section cut from a spare frame at FRCE.

"Sheet metal reinforcements, called 'doublers' would be needed to mate the donor section with the undamaged portion of the frame, which remained in the aircraft," Greenwood said. "The challenge for FRCE was to manufacture the reinforcement doublers and get them to the ship for the repair."

Sheet metal forming tools and flat patterns were designed on June 25 using the Original Equipment Manufacturer (OEM) CAD model information. Within 48 hours of receipt of the OEM CAD model, tool design was complete and 3-D printing of the forming tools began.

"The tools were built using a polycarbonate material chosen because it has a high compressive strength that can withstand high-pressure presses up to 4,000 pounds per square inch (psi)," Greenwood said.

One forming tool took five hours to build, while the second set took about 30 hours.

"Using traditional, nondigital tool design and building processes, manufacture of the doublers would likely have taken two to three weeks," Greenwood said. "Using the 3-D digital data and AM, time and cost were reduced significantly."

After the AM forming tools were complete, the flat patterns were formed, using the tools, into the doubler parts on June 28. Fit-up and quality checks took place concurrently with the forming process. After forming, the parts were heat-treated and painted.

"On July 2, one week after receipt of the solid model of the frame, both sets were on their way to the Bataan to repair the damaged aircraft," Greenwood said.



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AM is being used at multiple Fleet Readiness Centers and NAVAIR locations.